Factors Influencing the Development of Literacy and Numeracy among Preschool Children in Rural Areas

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ABSTRACT

This study aims to identify the factors influencing the development of literacy and numeracy among preschool children in rural areas. Literacy and numeracy are critical aspects of early cognitive development that determine a child's ability to succeed in formal learning. This study employs a quantitative approach using a questionnaire instrument developed based on previous literature and learning theories such as Piaget, Vygotsky and Bruner. A total of 62 preschool teachers in Hulu Selangor were involved as study respondents. The findings indicate that factors such as basic facilities, classroom environment, the use of technology, teacher teaching methods, and parental involvement play a significant role in supporting children's literacy and numeracy development. This article also presents practical recommendations to the relevant authorities and suggests directions for future research.

Keywords: influencing factors, literacy, numeracy, preschool children, rural

INTRODUCTION

Literacy and numeracy are the cornerstones of early childhood education as they provide the foundation for the acquisition of knowledge at subsequent stages. According to the Malaysian Ministry of Education (MoE, 2017), mastery of literacy and numeracy is a prerequisite for more complex learning when children enter the formal education system. However, in the context of rural areas, the challenges faced are more pronounced compared to urban areas. Issues such as a lack of educational resources, varying levels of parental involvement, socioeconomic disparities, and the poor quality of preschool environments often hinder the development of literacy and numeracy (Purva et al., 2022). Therefore, examining the factors that influence literacy and numeracy development among rural children is crucial for designing relevant and effective intervention strategies.

Past studies have shown that the development of literacy and numeracy does not solely depend on teaching approaches but is also influenced by the broader educational ecosystem (Amortia & Suminar, 2021). The family serves as the primary ecosystem influencing a child's development. Isa and Abdul Hamid (2012) found that parental literacy activities at home, such as reading with their children, providing reading materials, and creating a reading space, do not yield a significant impact if not carried out consistently. This indicates that simply providing reading materials is insufficient; instead, a more systematic and continuous routine is required. Jalal et al. (2014) reported that parental involvement at the PERMATA Negara Child Centres (PAPN) within rural areas remains moderate. Although parents' perceptions of the centre's role are positive, work time constraints limit their involvement in educational activities, thereby affecting the continuity of literacy and numeracy support at home. These findings are consistent with international evidence which emphasise that direct parental involvement is a key determinant of early literacy success (Fantuzzo et al., 2000).

Socioeconomic factors also have a significant role in determining the literacy and numeracy levels of rural children. Rahman et al. (2023) reported that children of mothers with a secondary education or higher are twice as likely to achieve literacy and numeracy compared to children of mothers with a lower education. Furthermore, activities such as reading books and telling stories by parents increase the odds of literacy-numeracy

development by up to 3.6 times. In Malaysia, the rural socioeconomic gap is also a significant factor, as children from low-income families often face a lack access to educational materials, limited learning environments, and conducive learning environments, and consistent parental support due to work demands (Jalal et al., 2014). This further strengthens the evidence that socioeconomic status not only determines access to resources but also influences the quality of parental involvement in a child's early education.

Furthermore, the concepts of the Home Literacy Environment (HLE) and Home Numeracy Environment (HNE) have been shown to be crucial in supporting early child achievement. Salminen et al. (2021) showed that early interactions such as reading together, conversations about letters and numbers, and numeracy-related games have a significant relationship with literacy and numeracy development from the ages of 2.5 to 6.5 years. This finding is supported by local evidence that emphasise the importance of consistent literacy routines at home, even in resource-limited settings (Isa & Abdul Hamid, 2012).

In the context of rural preschool institutions, teacher quality and pedagogical practices are equally influential. Although the PERMATA Negara Child Centres (PAPN) provides various parent- involvement activities, participation levels remain limited due to time constraints (Jalal et al., 2014). Nonetheless, effective teacher communication and receptiveness succeed in increasing parents' trust in the educational institution and facilitate collaboration in their child's learning. Teachers with strong literacy competencies are better positioned to implement activities that emphasise the integrated development of language and basic numeracy, while limited professional training among rural educators constrains curriculum implementation (Amortia & Suminar, 2021). Finally, children's internal factors also impact literacy and numeracy achievement. Rahman et al. (2023) found that stunting due to malnutrition negatively affects literacy and numeracy achievement in rural areas. Cognitive studies further highlight executive function skills such as self-control, working memory, and attention as important predictors of early literacy and numeracy success (Salminen et al., 2021).

Overall, the literature review highlights that the development of preschool literacy and numeracy in rural areas is influenced by intersecting family, socioeconomic status, home, and institutional factors, as well as the child's cognitive and health aspects. A comprehensive understanding of these factors allows for the formulation of more targeted, contextual, and effective intervention strategies to enhance literacy and numeracy achievement among rural children in Malaysia.

METHODOLOGY

This study employs a descriptive quantitative design with a survey approach. The primary instrument is a questionnaire developed from prior literature and relevant theoretical frameworks. The questionnaire comprises 15 items covering five main dimensions: (i) basic facilities, (ii) classroom environment, (iii) use of technology, (iv) teaching approach, and (v) parental involvement. A total of 62 preschool teachers in Hulu Selangor were purposively participated in the study. Data were analysed using version 30 of the Statistical Package for the Social Sciences (SPSS) software to obtain mean scores, standard deviations, and to make descriptive interpretations of the level of influence of each factor on literacy and numeracy development.

FINDINGS AND DISCUSSION OF THE STUDY

This study examines the factors influencing the development of literacy and numeracy among preschool children in rural areas. Overall, the findings indicate that factors such as basic facilities, classroom environment, the use of educational technology, teacher teaching methods, and parental involvement play a significant role in strengthening children's early achievements. These findings confirm that the development of literacy and numeracy is not solely dependent on an individual child's abilities but is also influenced by the broader educational ecosystem encompassing the school, family, and community, as emphasised by Bronfenbrenner's ecological framework.

Basic Facilities and Classroom Environment

The findings indicate that the factors of basic facilities and the classroom environment are among the most dominant determinants of literacy and numeracy development among rural preschool children, with the

respective highest means of 4.75 and 4.72. The presence of adequate infrastructure, such as electricity, clean water, internet connectivity, and ergonomic classroom design, directly enhances concentration, motivation, and social interaction among pupils (Jiang et al., 2025). This finding aligns with Bronfenbrenner's (1979) ecological theory, which posits that early learning is influenced by the physical and social microsystems on early learning. Conversely, deficiencies of basic facilities, such as sanitation, teaching aids and outdated ICT equipment, often hinders curriculum implementation in rural areas, as similarly reported in South Africa (du Plessis & Mestry, 2019).

A conducive learning environment is also closely linked to Vygotsky's (1978) theory of social constructivism, where social interaction within the Zone of Proximal Development (ZPD) can only occur effectively when there is sufficient physical space and material resources. Without supportive environments, the guided instruction and collaborative activities that are fundamental to early literacy and numeracy skills will be limited. A comfortable and organised environment also has a positive impact on pupils' emotional and cognitive well-being. Conversely, overcrowded, hot, and under-resourced classrooms can disrupt concentration and diminish the desire to learn (Argumedo et al., 2025; Salminen et al., 2021).

In Malaysian, the Education Blueprint 2013–2025 underscores equitable access to quality education in rural areas. However, a significant gap in basic facilities still exists between urban and rural schools. Therefore, providing the minimum infrastructure that supports 21st-century learning must be a policy priority. A safe and functional classroom environment is not merely a logistical factor, but a fundamental component that builds children's motivation, interest, and long-term learning potential. Investing in physical facilities and educational technology in rural areas not only enhances the quality of teaching but also serves as a strategic measure to reduce educational inequality and ensure every child has access to inclusive and meaningful learning opportunities (Rowe, 2022).

Teaching Methods of Teachers

The findings reveal that teachers' teaching methods are key determinants of early literacy and numeracy development of preschool children, with a mean score of 4.51. Teachers serve not only as transmitters of knowledge but also as facilitators who create meaningful learning experiences through pupil-centred activities. Active, contextual and play-based learning methods have been proven to increase pupil engagement as well as encourage critical thinking, logical reasoning and language expression (Chambers, Cheung, & Slavin, 2016). This approach aligns with the constructivist theories of Piaget (1952) and Vygotsky (1978), which emphasise that children construct knowledge through active experience and social interaction. In the context of literacy and numeracy learning, activities such as "storytelling with numbers", role-playing, or the manipulation of concrete materials allow pupils to understand abstract concepts more deeply through exploration and real-life experiences.

The effectiveness of this pedagogy is highly dependent on the teacher's professional competence and pedagogical reflection. Teachers who can adapt teaching strategies to the needs and developmental level of pupils will be more successful in fostering meaningful learning. Landry et al. (2006) highlight that continuous professional training focused on literacy and numeracy teaching can enhance the quality of teacher–pupil interactions and learning outcomes. While Cunningham et al. (2015) stress the importance of teacher learning communities that provide space for teachers to share best practices, re-evaluate teaching strategies, and build more reflective pedagogical competence. In the Malaysian context, teachers in rural areas often face resource limitations and restricted professional exposure; thus, community-based training and on-site coaching approaches should be expanded to support more effective professional development.

Furthermore, teaching methods that integrate technology and multi-sensory approaches also play a crucial role in strengthening literacy skills and numeracy. Digital aids, interactive videos, and app-based games reinforce pupils' understanding of basic concepts in engaging ways (Colliver, Arguel, & Parrila, 2021). The study by Grace and Suminar (2021) indicates that technology-based learning strategies not only enhance concentration but also accelerate the mastery of reading and numeracy skills among preschool children. However, teachers must ensure that this technological integration is pedagogically driven, rather than merely the use of digital tools. An integrated approach, combined with collaborative and reflective activities, is more effective in holistically

building social, language, and cognitive skills. Therefore, in the context of rural preschools, the effectiveness of teaching methods depends on the teacher's ability to adapt their strategies to the local context, balancing traditional and innovative approaches, and utilising local resources as a meaningful and inclusive medium for learning.

Use of Technology

The study's findings recorded a mean score of 4.33. Although not the highest-ranking factor, the findings indicate that the use of educational technology has a positive impact on the literacy and numeracy development of preschool children, despite infrastructural constraints in rural areas remaining a major challenge. Technology such as tablets, interactive applications, and smartboards can enhance pupils' focus, engagement, and motivation when used in a guided manner (Grace & Suminar, 2021). In the context of early learning, the use of interactive technology can stimulate pupils' cognitive, visual, and kinaesthetic processes through play-based learning activities. The study by Colliver et al. (2021) also showed that the structured integration of digital literacy activities, such as digital storytelling and 'phonics games', can strengthen reading, writing, and numeracy skills at the preschool level. Technology serves not merely as a teaching aid, but as an integrated learning medium that can bridge the gap between formal experiences at school and informal learning at home.

However, the effective implementation of educational technology depends on the readiness of infrastructure and the digital competence of teachers. The study by Nedungadi et al. (2018) emphasises that access to devices and an Internet connection alone does not guarantee the success of digital learning if teachers lack technology-based pedagogical skills (TPACK). In the context of rural Malaysia, teachers often face challenges such as a lack of digital equipment, intermittent Internet connectivity, and limited ICT training. This results in a superficial integration of technology that is less utilised for meaningful teaching. Therefore, an approach that combines community-based training and digital mentoring should be considered to strengthen digital literacy and increase their confidence in using technology as a primary pedagogical tool.

Furthermore, parental involvement in supporting technology use at home also plays a crucial role in reinforcing literacy and numeracy learning. Studies by Napoli et al. (2021) and Guo et al. (2020) indicate that when parents engage in digital learning activities, such as reading interactive books with their children, the children's language and maths skills improve more significantly. However, in rural communities, parents' digital literacy levels remain low and often become a barrier to continuous learning at home. Therefore, basic technology training for parents needs to be implemented inclusively so that they can monitor and guide their children in using digital media safely and meaningfully. Overall, the success of integrating educational technology in the context of rural preschools depends on a balance between the provision of infrastructure, teacher professional development, and active parental involvement to create a holistic and locally contextualised digital learning ecosystem.

Parental Involvement and the Home Learning Environment

The study's findings indicate a mean score of 4.16. This result underscores the crucial role of parental involvement in shaping the home literacy environment (HLE) and home numeracy environment (HNE), which are vital for reinforcing early literacy and numeracy development in children. Parents act as the first educators, introducing language, reading, and basic mathematical experiences through daily activities such as storytelling, singing, counting items at home, or writing together. The study by Aram and Levin (2014) indicates that the practice of reading and writing together with parents not only enhances phonological skills and vocabulary but also fosters a positive attitude towards learning. Guo et al. (2020) found that consistent parental involvement in writing activities, reading aloud, and the presence of reading materials at home was highly correlated with children's early literacy achievement. This aligns with the principles of Vygotsky's (1978) theory, which asserts that social interaction and guidance within the family context are fundamental to a child's early cognitive development within the Zone of Proximal Development (ZPD).

However, parental involvement among low-income and rural families is often limited by time constraints, educational attainment, and functional literacy. The study by Zgourou et al. (2021) shows that in low-income communities, children who are more proactive in initiating reading or numeracy activities themselves acquire higher language skills compared to those who simply wait for parental instruction. This suggests that parental

involvement does not necessarily have to be formal but can take the form of encouragement and indirect support that gives children the space to explore and learn independently. In the Malaysian context, parents in rural areas often face challenges such as work constraints and a lack of reading materials that are culturally appropriate. Therefore, community initiatives such as reading corners, family reading days, or the use of local reading materials in the mother tongue can help to increase parental involvement in a practical and sustainable way.

Furthermore, these findings also reinforce Bronfenbrenner's (1979) ecological theory, which emphasises that the family and community are crucial microsystems that influence a child's development. A home environment rich in literacy and numeracy activities not only provides cognitive input but also fosters social values such as communication, responsibility, and academic discipline. Studies by Dulay et al. (2019) and Salminen et al. (2021) also found that children living in home environments that support language interaction and daily maths activities demonstrate better academic performance when they enter formal schooling. In this context, community-based literacy programmes and parenting training, such as parent coaching and home-based numeracy kits, can be effective strategies to strengthen the role of parents. Therefore, to ensure continuous learning between home and school, the Malaysian Ministry of Education needs to expand the implementation of parent support programmes in rural areas, so that families can play a key role as partners in strengthening children's literacy and numeracy foundations from an early age. This factor records a variation in scores between high and moderate depending on the school's location and the pupils' family background. Items such as "reading together at home" and "parents monitoring homework" show a positive impact on early cognitive development. However, some teachers state challenges such as a lack of parental awareness about the importance of early support at home.

IMPLICATIONS AND RECOMMENDATIONS OF THE STUDY

This study has significant implications for various stakeholders, including policymakers, educators, teacher training institutions, as well as families and communities. The findings underscore that the development of early literacy and numeracy does not merely depend on an individual's cognitive abilities, but is also influenced by the educational environment, pupil well-being, and comprehensive social support. Based on Bronfenbrenner's (1979) ecological theory, school readiness is shaped through the interaction of various environmental systems; therefore, interventions must be implemented holistically and interactively. In the context of Malaysian education policy, these findings reinforce the need to broaden the focus from curriculum alone to a comprehensive support system, including the provision of physical infrastructure, professional teacher training, and active family and community involvement in strengthening the foundations of preschool literacy and numeracy.

In terms of policy, the Malaysian Ministry of Education (MOE) is advised to strengthen its rural preschool development strategy by prioritising the improvement of basic facilities and the provision of digital resources. Although the Malaysia Education Blueprint (MEB) 2013–2025 emphasises equitable access to early education, its implementation must be accompanied by regular monitoring and effectiveness evaluation. Infrastructure such as a clean water supply, electricity, and a stable internet not only enhances the quality of learning but also opens opportunities for innovative technology-based pedagogy (Nedungadi et al., 2018). At the same time, education policy must strengthen aspects of pupil well-being, including nutrition and physical health, as balanced nutrition has been shown to improve concentration and cognitive performance (Argumedo et al., 2025).

The implications for teacher training, in turn, demand a continuous professional development approach that is relevant to the local context. Teachers need to be trained to apply student-centred strategies and a social constructivist approach so that they can create enjoyable, active learning experiences. Studies by Landry et al. (2006) and Cunningham et al. (2015) indicate that community-based learning and peer coaching can enhance the quality of teacher–student interactions and pedagogical confidence. In rural contexts, flexible training mechanisms such as field mentoring and best-practice sharing are recommended to ensure the effectiveness of literacy and numeracy teaching is aligned with students' actual needs.

For families and communities, the findings underscore the need to strengthen home learning environments that support literacy and numeracy activities. Parental involvement in reading, playing with numbers, and storytelling has been shown to enhance children's language development and logical thinking (Aram & Levin, 2014; Guo et

al., 2020). Therefore, educational agencies are advised to introduce parenting training programmes, such as family literacy workshops or home-based numeracy kits, to support home-based learning (Dulay et al., 2019). At the same time, further research is recommended to explore longitudinal and multi-level study designs to assess the long- term effects of these interventions (Salminen et al., 2021). Overall, the development of literacy and numeracy in rural areas must be based on an ecosystem approach that integrates policy, pedagogy, community, and local culture, so that early education not only improves academic achievement but also serves as a catalyst for the nation's well- being and social justice (Rowe, 2022).

CONCLUSION

Overall, this study emphasises that the development of literacy and numeracy among preschool children is the result of the interplay of multiple interconnected factors, including the physical environment, pedagogical approaches, the use of educational technology, and family support. The effectiveness of early learning depends on the synergy between a conducive school environment, competent teachers, active parental involvement, and access to relevant learning resources and materials. These four elements are crucial in shaping a meaningful, enjoyable, and inclusive learning experience for all children, particularly in rural areas.

The findings further affirm that investment in early childhood education has a long-term impact on academic achievement, social well-being, and economic mobility (Rowe, 2022; Salminen et al., 2021). Therefore, efforts to strengthen literacy and numeracy must be implemented comprehensively through the reinforcement of education policies, the enhancement of basic infrastructure, professional teacher training, and the fostering of community and family engagement. This systemic approach can reduce disparities between urban and rural children, while ensuring equitable access to quality learning opportunities for all social strata.

Ultimately, the success of strengthening preschool literacy and numeracy does not depend on a single party, but requires continuous collaboration between the government, educational institutions, teachers, parents, and the community. By implementing a holistic, evidence-based approach that is locally contextualised, Malaysia's early childhood education system can produce a generation that is not only literate and numerate, but also well-rounded in their cognitive, emotional, social, and human values, in line with the aspirations of the National Education Philosophy.

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